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2001

Faculteit der Economische Wetenschappen en Bedrijfskunde

SERIE RESEARCH MEMORANDA

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Research Memorandum 2001-24

June 2001

vrije Universiteit amsterdam

SHARED CHOICES ON LOCAL SUSTAINABILITY PROJECTS: A DECISION SUPPORT FRAMEWORK

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Abstract
The aim of this study is to build a decision support framework for helping local govemments in the identification of sustainable strategies, using a combination of various multi-criteria evaluation methods.
The first part of the paper emphasises the importance of multi-criteria methods in the construction of a participative process aimed at the creation and implementation of Local Agenda 2 1, and justifies the choice of several complementary multi-criteria methods deployed (the Regime analysis, the Saaty method, and the NAIADE method, together with the Flag model) as tools to reduce policy conflicts and to reach a shared or joint choice in a decision-making process with multiple actors or interests.
In the second part of the paper the above-mentioned methods are tested on a real world case involving the conservation and improvement of a natura1 resource, viz. Lake Miseno in the south of Italy. Lake Miseno located in the Campania Region is nowadays characterised by a deep controversy on maintaining the typical historica1 attributes of this area of exceptional archaeological and natura1 importance on the one hand, and the devastating urbanisation process on the other hand.
This study proposes four altemative projects for the rehabilitation and re-qualification of this natura1 resource and develops an evaluation approach for the best strategy to meet the goal of sustainable development.

key words: natura1 resource, local govemment, evaluation, participation, shared choice

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1. Decision Support Systems for Assessing Alternative Projects in Local Planning Processes

1.1. Introduction

Planning processes in our modem world have become extremely complicated and drawn-out. This unfortunate situation is the outcome of many factors, in particular the diverse nature of modem planning issues, the many conflicting issues (e.g. development versus environment), the lack of public funds and the like. Consequently, the planning procedures on land use and environment – in both urban and rural areas – lead nowadays to a delayed implementation of public policy and indirectly bring about extremely high social costs and unrest. The typical response of public authorities to many planning challenges has been to reinforce the institutional framework, without due regard for the mechanisms of conflict resolution. It is surprising to see that in recent literature on decision-making and public choice analysis, a vast array of modem operational decision support tools is presented that could be implemented for complex decision procedures in the public sector.

In this paper we use an Italian case study – Lake Miseno – to illustrate some of the complexities involved and to demonstrate the potential of modem decision support tools.

1.2. The Italian "Renewal plan" as a practica1 tool for valorisation of natura1 resources

The reform law of Public Administration and administrative simplification emanated in Italy in 1997, better known as "the Bassanini law"; Art. 22 decrees that the administrative functions of the State regarding the use and management of the mineral and thermal waters are transferred to the Regions. To pursue this autonomy, the Regions, the autonomous Province and the Municipality have to present the Department of the Treasury inter alia with a "Renewal plan" of the environmental resources concemed, aimed in principle to improve the budget passivity of the relevant stakeholders by specifying the interventions, the resources and the time of realisation.

The "Renewal Plan of the Commune of Bacoli" dated June 1997, Art. 22 law 59/97 was approved by the Department of the Treasury in September 1997. As a result of this document the Commune of Bacoli has taken possession of the two lakes Miseno and Fusaro and of the pertinent territories, and it has now the possibility to oversee strategic actions for the conservation and environmental re-qualification of these resources. The main objectives of the Renewal Plan are:

a) conservation and environmental improvement
b) creation of recreational, sporting and tourist activity
c) creation of commercial and industrial activity
d) improvement of social and cultural quality.

As indicated in Section 3.2, the Public Administration has proposed two alternative policy scenarios to reach such objectives. Moreover, the experts involved in the planning process

(see also Section 3.2) have considered two further alternatives, which are more concerned with enviromnental and social issues.

In fact, if the Renewal Plan is to be considered as a starting point for the implementation of Local Agenda 21, the choice and evaluation of the proposed alternatives cannot be considered as a "one shot action". They represent a gradual process of acquisition of information through participation, the construction of consensus, and the formulation of altemative hypotheses which respect the genera1 objectives of sustainable development, viz. the pursuit of eco-systemic integrity, economic efficiency, and social and intergenerational equity. These, after all, are the objectives of sustainable development, which are valid at any leve1 (intemational, national or local). They converge in the identification of specific objectives to be defined on a "case to case basis", where every community must find its own best way.

Taking the specifíc nature of the sites into consideration, Agenda 21 actually calls upon local authorities to equip themselves with their own agenda through a dialogue with the citizens, and to acquire the necessary information for the formulation of the "best" relevant strategies.

It is evident that the different parties involved, whether public entities, private individuals or the non-profit sector, pursue heterogeneous and multidimensional objectives. Their pursuit causes conflicts of different nature, which must be taken into account.

In the next section we will outline how multi-criteria methods could be useful tools in the construction of such a process. We will focus, in particular, on some recently developed Multi-criteria methods (the Regime analysis, the Saaty method, the NAIADE method, and the Flag model) for the support of the activities of the local govemment in the definition and operationalisation of strategies of sustainability for the improvement of Lake Miseno.

2. Multi-criteria Analysis of Policy Scenarios on Local Renewal: the Choice of Evaluation Methods

Plan and project evaluations have become an important component of modem public planning and administration. Especially in the socio-economie and physical planning process, nowadays much attention is paid to the assessment and appraisal of altemative policy options. In this respect, decision-making is not considered to be a "one shot" activity but part of a process in which choice possibilities, relevant criteria and urgency of choice, gradually become clearer (see Nijkamp et al. 1990).

The complexity of reality and the conflicting objectives in policy games do not often allow US to analyse problems from an unambiguous point of view. Therefore, we are faced with the need for an evaluation tool that reflects the main objectives proposed in the framework of Local Agenda 21 (see Section 1): a tool of analysis and consulting; a tool to share proposals, to identify new projects; to control results; to promote better capacity use; to facilitate coalition and CO- operation; to construct public choices in a participative, organised and interactive process for integrating social, economic and ecological goals.

Multi-criteria evaluation methods appear to be the most appropriate for Local Agenda 21 in overcoming the limitations of conventional monetary approaches such as cost-benefit analysis

in its attempt to measure all effects in monetary units (including intangible and incommensurable effects), which reflect the complexity of the reality under analysis.

We will focus our attention on some promising particular multi-criteria methods based on both ordinal and mixed ordinal-cardinal data: the Regime method, the Saaty method, and the NAIADE method, complemented with the recent Flag model.

- Regime analysis is a discrete multi-criteria method (Nijkamp et al., 1990). The fundamental framework of this multi-criteria method is based upon two standard kinds of input data: an evaluation matrix and a set of politica1 weights. The evaluation matrix is composed of elements that measure the effect of each alternative considered in relation to each relevant criterion. The set of weights provides information about the relative importance of criteria to be considered. Regime analysis in its qualitative version is an ordinal generalisation of pair-wise comparison methods that can examine quantitative as well as qualitative data.
- The Saaty method (Analytic Hierarchy Process-AHP) (Saaty, 1980; Saaty and Vargas, 1982; Saaty, 1994) is based on three important components:
  - The hierarchical articulation of the elements of the decision problem
  - The identification of the priorities
  - A check on the logic consistency of the priorities.
- The NAIADE method (Novel Approach to Imprecise Assessment and Decision Environments) (Munda, 1995) is a discrete multi-criteria method whose impact (or evaluation) matrix may include crisp, stochastic or fùzzy measurements of the performance of an alternative with respect to an evaluation criterion. It is, therefore, very flexible for real-world applications. Using a pair-wise comparison technique, NAIADE generates a ranking of alternatives. It allows two types of evaluations. The first is based on the score values assigned to the criteria of each altemative and is performed using an impact matrix. The second analyzes conflicts among the different interest groups and the possible formation of coalitions in regard to the proposed altematives, using an equity matrix, based on a linguistic evaluation of altematives by each group.

  The method is essentially divided into four main parts:
  - Pair-wise comparison of altematives by using preference relations
  - Aggregation of all criteria
  - Ranking of altematives
  - Equity analysis.
- The Flag model has been developed in order to assess the degree of sustainability of values of policy altematives (Nijkamp, 1995; Nijkamp and Ouwersloot, 1997). The model develops an operational description and defmition of the concept of sustainable development based on critical threshold values.

  This model achieves three important functions:
  - It identifies a set of sustainability indicators.
  - It establishes a set of normative reference values.
  - It develops a practica1 methodology for assessing future developments from a

sustainability perspective.

The critical threshold value represents the reference system for judging actual states or future outcomes of policies or scenario experiments.

This study proposes the integration of the above described multi-criteria methods (the Regime method, the Saaty method, the NAIADE model followed by the Flag model) with the aim to develop a tool to reduce conflicts and to create communication and consensus in a decision making process. As previously indicated, such an approach simultaneously can investigate the impact of a policy strategy on relevant criteria, partly monetary, partly non-monetary (including qualitative facets).

In the next section, this methodology is tested in an empirical case study based on the choice of project alternatives for the conservation and the improvement of Lake Miseno and its socio-economie development. The main goal is to achieve a "good choice", such that it is possible to make a policy contribution by combining common knowledge (being the knowledge of citizens plus technical knowledge) through a democratic participation.

The Regime analysis is used as a tool to initiate a dialogue or communicative process between policy-makers and experts in the choice of altemative projects, and to pinpoint conflicting goals. The integration of the Saaty method with the Regime analysis can handle the problem of subjectivity of policy-makers and experts in the weight choice procedure. The NAIADE method is used to check the leve1 of aggregation among different stakeholders in respect to a ranking of altematives, capturing in a so-called forum group the preferences of each part involved. The Flag model then finally checks the sustainability of the altematives in relation to a set of critical threshold values.

We can summarise the main characteristics of the above-mentioned methods in Table 1. Moreover, we can observe how the combination of these methods can create a useful assessment procedure composed of five steps, which make it possible to collect different information for the final choice of altematives and to pinpoint the conflicts that arise (see also Figure 1).

	REGIME	AHP	NAIADE	FLAG
Input	• Impact matrix • Weight vector	• Tree of criteria	• Impact matrix • Equity matrix	• Impact matrix • Critical threshold value
Output	• Rank order of alternatives	• Weight vector	• Rank order of alternatives • Level of aggregation	• Level of sustainability of each altemative • Comparison among the alternatives
Possibility to handle mix date	Yes	Yes	Yes	Yes
Level of participation of Decision Making	• Difficulty to assess the weight vector.	• Interview (simple questions, but long questionnaires).	• Judgement on the alternatives expressed in a forum group.	• Possibility to quickly check the impact of different alternatives
Level of participation of Community	• Difficulty to assess the weight vector	• Interview (simple questions, but long questionnaire). • Difficulty to inter-view many people.	• Judgement of the altematives expressed in a forum group.	• Possibility to quickly check the impact of different altematives

Table 1 *Comparison of methods*

3. A Case Study on Lake Miseno

In this section we will illustrate the application of the previous multi-criteria methods on the basis of a real-world case regarding the choice of the most suitable use of Lake Miseno in Italy to conserve and improve its socio-economie development.

First, we describe the main characteristics of the area (physical, enviromnental, and socio-economic aspects) to highlight the complexity and the intrinsic value of the area under analysis and to identify the "soft" and "hard" information that plays a role in the choice of alternative projects. Secondly, we illustrate the methodology followed by a specification of the input data (the impact matrix, the weight system and the equity matrix), and the application of the above- mentioned method to the choice problem using the Saaty method to calculate the politica1 weights; the Regime analysis to obtain a rank order of alternatives; the Flag model to check the sustainability of the alternatives in relation to a set of critical threshold values; and the NAIADE method to capture the qualitative judgement of various significant groups on the proposed alternatives, through a forum group. Finally, we compare the results obtained using these different methods to check the feasibility of the solution and the reliability of the methods.

3.1. The territoria1 context

Lake Miseno is located in the Municipality of Bacoli (with approximately 27,000 inhabitants), in the Province of Naples, one of the most lively tourist and industrial centres of the Phlegraean Area. The Phlegraean Area located in the Campania Region is an area of exceptional archaeological and natura1 importance, marked by a deep divergence between the typical attributes of the area and the devastating urbanisation process started in the later part of the 1950's and resulting in significant losses in its resource base.

In the past, the Municipality of Bacoli was a heavy industry area, which for many years produced growth and employment. The closing-down of many factories, together with the industrial decline in the entire Phlegraean Area, led to a situation of extreme difficult socio-economic conditions due to the failure of the local government to improve the existing environmental and historica1 resources. One of these resources is Lake Miseno, which for years has been in a state of deterioration.

Originally, the State owned the lake, but in 1961 its management and the management of the surrounding areas and buildings was transferred to a state-controlled company (Tarantino-Campano Ichthyic Centre) with the aim to develop activities such as fishing and mussel breeding. During its 30 years of management, however, the company was phased out and gradually dropped its activities, with the result that the lake and surrounding areas and buildings deteriorated. In 1997, the Local Government took over the Lake on grounds of the above-mentioned Bassanini Law (see Section 1.2), and it is now responsible for its management. This presented a major opportunity for the Municipality of Bacoli, not only for the reclaiming of the Lake but also for initiating a complex local sustainable development.

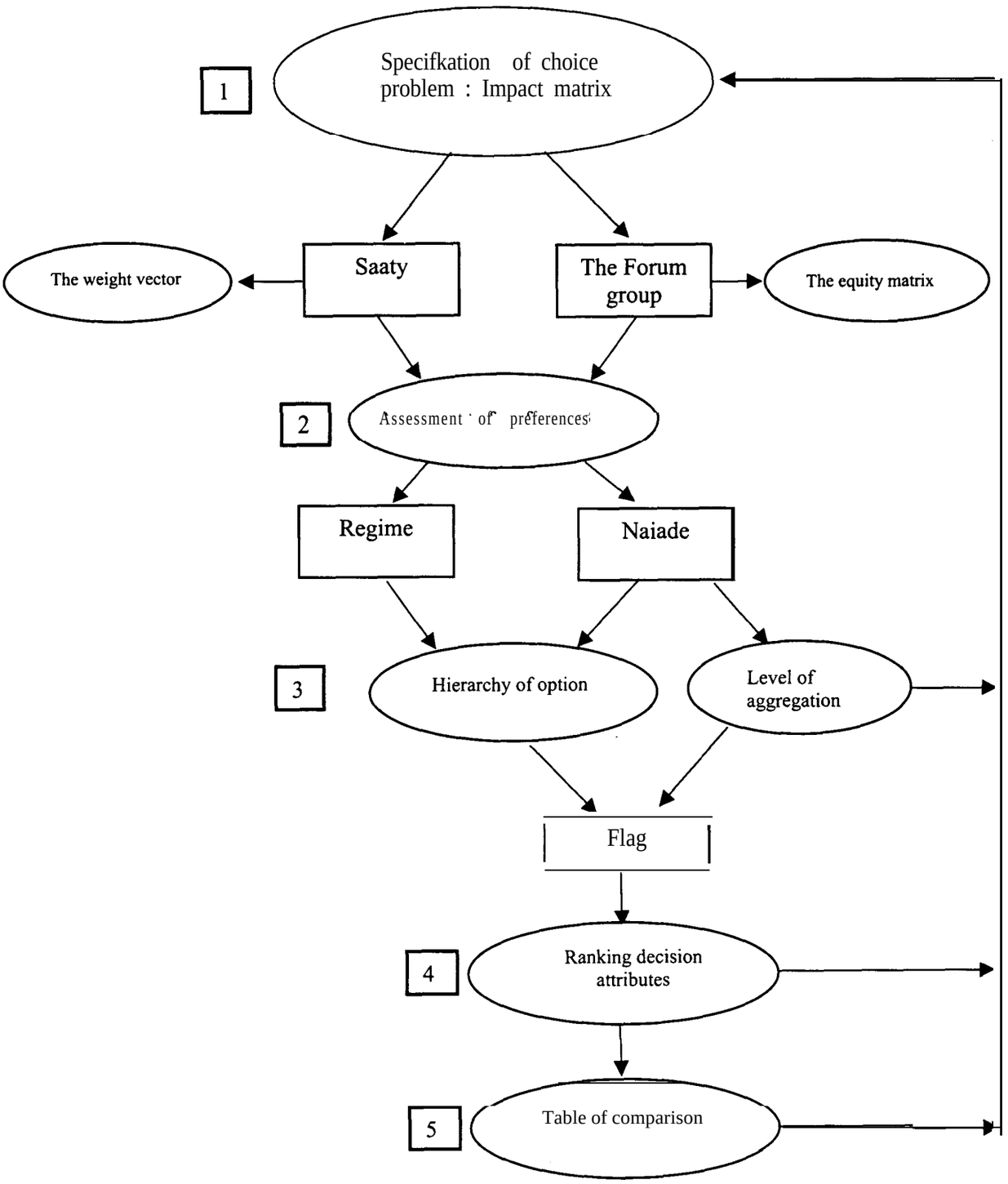


Figure 1 *Assessment process using a combination of methods*

The resources of Lake Miseno consist of:

1. The fishing lake, with a surface of 47,500 hectare and a perimeter of 2,9 kilometres. The lake has two outlets to the sea.
2. Three buildings for fishing activities.
3. An area of 21,334 hectares where the Navy has built six masonry sheds.

The main problems that afflict this area include:

- a high degree of biological pollution of the lake
- a lack of local economic development and a high leve1 of unemployment (from the local population of 27,000 inhabitants, more than 2,500 are unemployed)
- the degradation of environmental, historica1 and architectural heritage
- the loss of local culture and tradition.

3.2. Goals and project alternatives

The analysis of the problems that are inherent to the area under examination, offers clear directions for the definition of specific sector and planning objectives for the conservation and improvement of the resources of Lake Miseno and the surrounding areas.

Foremost, the high leve1 of biological pollution of the lake (high levels of ammonia, phosphorus, and cyanide, as well as extremely high bacterial content, non-existent phytoplankton, and very low oxygen content) makes a hygienic-sanitary and environmental clean-up intervention a top priority, in the absence of which any local development program is unthinkable.

Secondly, the unemployment levels recorded in the Municipality of Bacoli call for a new stimulus of the local economy. This could be achieved by encouraging entrepreneurship in the field of mussel breeding, fishing and fish farming, which for centuries were vita1 activities in this area.

In addition, the vast assets represented by the landscape/environmental and historical/architectural resources, as well as the local traditions and culture constitute the foundation upon which the cultural and social revival of the local community, and its tourist development, must be based.

These objectives were announced by the Municipal Administration in its "Renewal Plan" for Lake Miseno, approved in 1997. In addition, the Local Government identified two altematives, both of which mention the cleaning up of the Lake and its adjacent areas as a priority. This would be undertaken by recovering the optimum conditions of water liveability at the outlet in order to restore the exchange of salt water, as well as on the bed of the lake.

The identified altematives will now briefly be described.

Alternative A: Lake Miseno Tourist Port

This altemative provides the construction of a tourist port for the boating community with facilities for approximately 3000 smal1 and medium boats. To achieve this, significant deepening, widening and equipping of the Miseno outlet would have to be carried out and piers for docking would have to be built (approximately 2,900 meters of stable piers were

planned in the Northern part of the lake). To protect the lake, a portion of it (approximately 200,000 square meters) would be set aside as a natura1 lake reserve. Using the existing buildings, the proposal was to establish cultural facilities (museums or libraries) linked to the local history and culture.

Alternative B: Lake Miseno Aqua-culture Centre

This altemative provides for an aquaculture centre on Lake Miseno, for the intensive production of mussels and particular species of fish. The implementation of these activities required intensive of works such as a limited widening and deepening of the "Miseno outlet" canal to facilitate access to the Lake by typical fish-farming boats. In addition, the development of this proposal implied a carefùl examination and forced adjustment of the biological conditions of the Lake.

These altematives proposed by the Local Govemment do not appear to take into consideration the ecological situation, since in different ways they would both cause a significant negative impact on the ecosystem of the lake. In fact, considering that sustainability of development requires the conservation and protection of the natura1 capita1 available; these two altematives are totally incompatible with the development of the infrastructure and the initiation of some of the activities provided for by the above proposals.

As already mentioned, naturally this may cause conflict, which is amplified by the absence of the necessary dialogue in the evaluation process, a condition that is essential for the construction of balanced choices and therefore of consensus.

From this standpoint, it was believed necessary to formulate other proposals that were more responsive to different local needs: economic and productive growth, use of landscape resources recognized by everyone, protection of the eco-biological equilibrium, etc.

Next, from the further investigation and new studies undertaken, starting with the previous "institutional" altematives. two further altematives were formulated.

Alternative C: Lake Miseno Natura1 Reserve

This altemative provides for the designation of the entire Lake as a natura1 reserve; it prohibits any exploitation that is not directly connected to the study and offers protection of the marine flora and fauna characteristic of the area.

Following the radical environmental clean-up of the Lake and the recovery of the optimum microbiological conditions of the water, this altemative requires constant initiatives related to the protection, maintenance and monitoring of the quality of the ecosystem through the continuous identifícation and evaluation of environmental parameters. It also demands study, research and the expansion of knowledge about typical flora-fauna components.

The existing premises could be destined for the installation of an observatory for local flora, migratory and non-migratory fauna, and to accommodate educational activities pertaining to local historica1 and cultural features. The prohibition of the free and direct use of the lake is aimed at the recovery of environmental conditions, which were once common for wildlife.

Alternative D: Lake Miseno Recreational Park

This plan suggests the construction of a large equipped park. The Lake, designated as a reserve of approximately 475,000 square meters, would be a site for rowing, swimming, sailing, sport fishing, tourist and boating entertainment activities, as well as culturally, historically and traditionally linked pastimes.

The construction of the recreational park provides for the widening and deepening of the Miseno outlet Canal to facilitate access for boats and the construction of a limited number of mobile docks. The latter will be approximately 800 meters long and will be periodically used for the docking of non-polluting motorboats, which will be allowed on the Lake. Museums, facilities for cultural events, and libraries on the history of the Phlegrean area and its archaeological, geological, wildlife and natura1 features may be housed in the existing buildings.

3.3. Hierarchical definition of criteria and evaluation of impact matrix

We will now define the evaluation criteria of the above-mentioned scenarios. This definition follows a hierarchic logic, which firstly considers a class of genera1 criteria that reflect the global objectives of sustainable development (see Agenda 21 Conference of Rio de Janeiro 1992). Chapter 8 of Agenda 2 1 "Integrating Environment and Development in Decision-making" aims to reach a development that is economically efficient, socially equitable and responsible, and environmentally sound. Taken from this perspective, the distinct genera1 criteria are:

- Economic efficiency
- Conservation of the ecosystem and environmental integrity, the local character and historica-cultural traditions
- Social and intergenerational equity.

For each of these genera1 criteria, more specific factors have been defined, which are mostly linked to local dimensions, and are respectful of the features, the problems and the characteristics of the area under analysis. The genera1 and local criteria have been organised according to a tree structure as shown in Figure 2. Due to the different nature of the above-mentioned criteria, reflected in the specific indices, the values of correspondence of each alternative with respect to each criterion are expressed on different scales: qualitative and quantitative. Such values are shown in the impact matrix in Table 2.

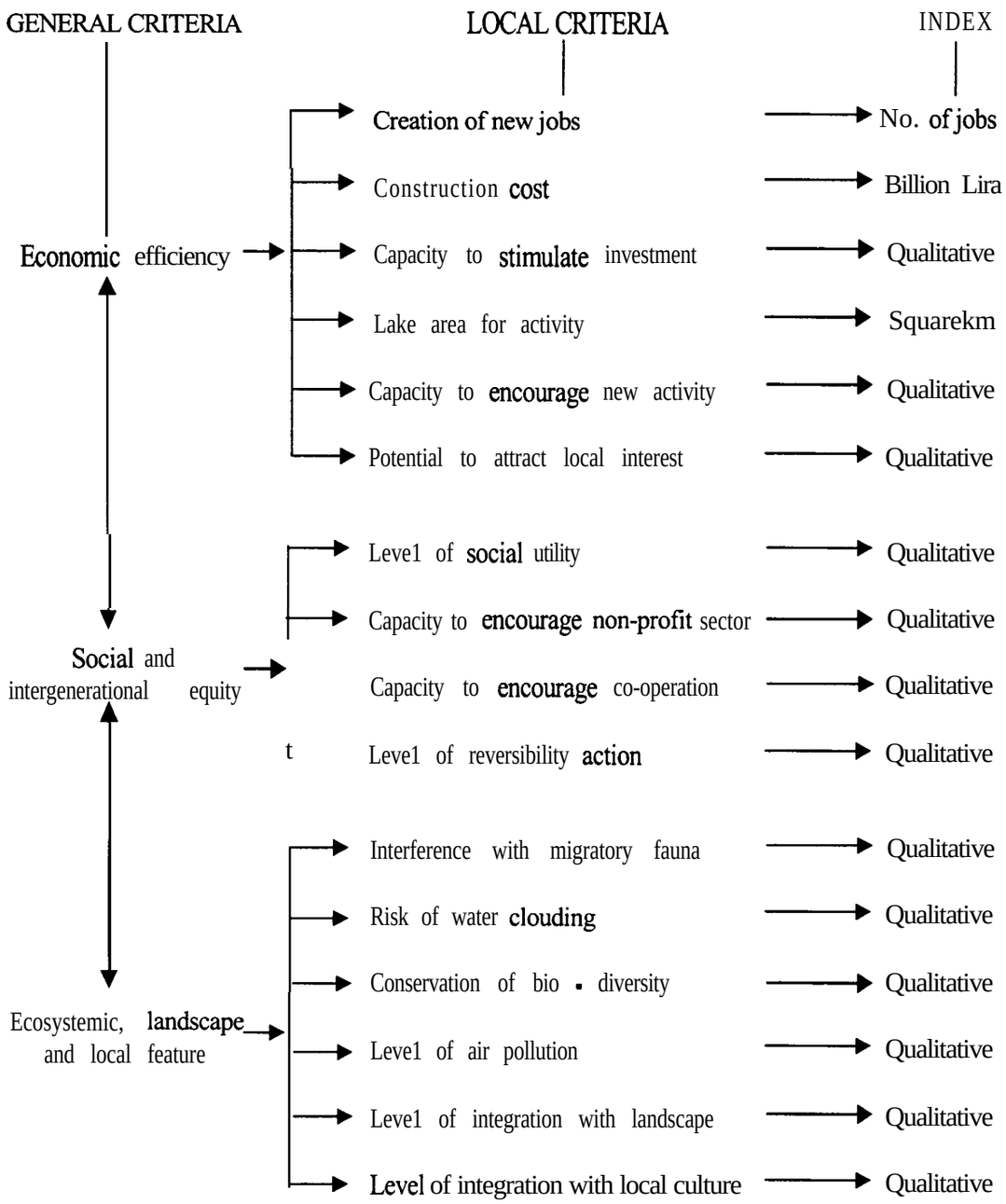


Figure 2 *Tree of decision criteria*

	CRITERION	INDEX	A	B	C	D
Economic	1) Creation of new job (+)	Number of jobs	140	117	73	125
	2) Construction costs (-)	Billion lira	60	55	70.3	51
	3) Capacity to stimulate investment (+)	Qualitative	Ext aood	Good	Bad	Good
	4) Lake area for activity (+)	Square km	275	275	0	475
	5) Capacity to encourage new activity (+)	Qualitative	Ext good	Moderate	Bad	Good
	6) Potential to attract local interest (+)	Qualitative	Ext good	Bad	Moderate	Ext good
Social	7) Leve1 of social utility (+)	Qualitative	Bad	Ext. bad	Bad	Ext. good
	8) Capacity to encourage non-profit sector (+)	Qualitative	Bad	Ext. bad	Moderate	Good
	9) Capacity to encourage cooperation(+)	Qualitative	Good	Ext. good	Bad	Good
	10) Leve1 of reversibilitv of action(+)	Qualitative	Ext. bad	Bad	Ext. good	Good
Environment	11) Interference with migratorv fauna(+)	Qualitative	Yes	Yes	No	N 0
	12) Risk of water cloudina (+)	Oualitative	Yes	Yes	No	No
	13) Conservation of bio • diversity (+)	Oualitative	No	N 0	Yes	Yes
	14) Leve1 of air pollution (+)	Qualitative	Bad	Good	Good	Moderate
	15) Leve1 of integration of landscape (+)	Qualitative	Ext. bad	Bad	Ext. good	Good
	16) Leve1 of integration with local culture(+)	Qualitative	Moderate	Bad	Moderate	Good

Table 2 *Impact matrix*

As shown in the impact matrix, the criteria (1,2,4) are expressed on a cardinal scale, while the criteria (3,5,6,7,8,9,10,14,15,16) are expressed on nomina1 scale (extremely good, good, moderate, bad, extremely bad), where the value extremely good (Ext. good) represents the optimal solution in comparison to the others.

In the following subsection we will present the weights assigned to each criterion as an expression of the priorities assigned by the experts and by the public administration.

3.4. The weight vector

The definition of the system of weights, or in other words, the identification of the priority rankings between the different criteria included in the impact matrix, is fundamentally a politica1 problem. In the present analysis the assignment of weights has been performed on the basis of the hierarchical logic described in Section 3.3.

Two weight systems have been specified. The first one refers to the main classes of judgement (economic, social, environment) and the second one to the sub-criteria. The latter set of weights strongly reflects the preferences of the politica1 class and of the technical experts involved in the project.

The vectors have been calculated with the aid of the Saaty Method software contained in the program for multi-criteria evaluations (SamiSoft program). This program, which reproduces the logic described in Section 2.3, allows US to derive a priority ranking through a paired

comparison between the criteria based on a 9-point scale (from 1 = equal important to 9 = extremely important). Moreover, the program allows us to verify the coherence of collected information through the specification of the principal eigenvalue. The first step of the methodology in this study consists of interviewing the politica1 class and the technical experts by means of a questionnaire based on Saaty's fundamental scale in order to identify subjects' preferences among the listed criteria.

The results of the interviews are then used for the calculus of two weight vectors employed in the evaluation. One expresses the views of the politica1 class, the other the views of the technical experts.

The analysis also considers a vector of uniform weights, in which for each criterion the priority is assumed to be irrelevant. In other words, all combinations of weights are equally probable.

Table 3 shows the results of the calculations for the three sets of weights. Analysing this results, we can see that:

- From the experts' point of view, when examining the economic criterion, they consider "*the creation of new jobs*" a relevant problem, assigning it the highest values. This result seems to be plausible, if we consider the high rate of unemployment in the area.
- Looking instead at the social criteria, the experts assign the highest value to the "*level of social utility*"; also this result is quite consistent with the objective of considering the re-qualification of the Lake as an opportunity to improve the quality of life generally for the people who live there.
- From an environmental point of view, they care most about the integration of the project into the landscape, in view of the amazing natura1 and cultural heritage of the area. But, even if the environmental issue seems to take priority over other criteria, when we look into the macro-criteria results, we find that the experts have rated both social and environmental issues highly.

In respect of the social criteria, the Public Administration expressed approximately the same preferences as the experts did. As for the environment, the conservation of bio-diversity was considered to be relevant and important.

Having collected the criteria preferences of these two groups involved in the construction of the alternatives and in the final choice, we will now analyse the preferences of six different groups on the proposed altematives in a forum group.

		Uniform weight		Experts weights		Public Administration weights	
		W_1	W_2	W_1	W_2	W_1	W_2
Economic	1) Creation of new job (+)	0.1666	0.33	0.427	0.49	0.178	0.684
	2) Construction costs (-)	0.1666		0.097		0.04	
	3) Capacity to stimulate investment (+)	0.1666		0.127		0.264	
	4) Lake area for activity (+)	0.1666		0.024		0.067	
	5) Capacity to encourage new activity (+)	0.1666		0.057		0.102	
	6) Potential to attract local interest (+)	0.1666		0.268		0.349	
Social	7) Level of social utility (+)	0.25	0.33	0.566	0.49	0.331	0.228
	8) Capacity to encourage non-profit sector (+)	0.25		0.046		0.268	
	9) Capacity to encourage cooperation (+)	0.25		0.25		0.178	
	10) Level of reversibility of action (+)	0.25		0.138		0.223	
Environment	11) Interference with migratory fauna (+)	0.1666	0.33	0.151	0.143	0.045	0.008
	12) Risk of water clouding (+)	0.1666		0.045		0.189	
	13) Conservation of bio - diversity (+)	0.1666		0.028		0.398	
	14) Level of air pollution (+)	0.1666		0.072		0.242	
	15) Level of integration of landscape (+)	0.1666		0.431		0.05	
	16) Level of integration with local culture (+)	0.1666		0.273		0.076	

Table 3 Table of alternatives weight systems

3.5. Organisation of Local Community preferences in a forum group

In this section we will collect the verdicts on the various development strategies, expressed by the different interest groups. The stated preferences regarding the different alternatives offer the possibility to reach an evaluation of the development strategies proposed in terms of absolute objectivity and transparency. The overall operation, which provides technical/scientific support to the politica1 decisions on the local development model, tends to emphasise the coalition between the social components as an essential instrument for the clear definition of the choices for urban transformation. Moreover, the method offers the opportunity to evaluate the coalition strategies between the groups in relation to the altematives, which automatically appear on the basis of shared priorities.

The representative groups were selected so as to address all social components presumably involved in the transformation of the area, based on the strategies for local development. Each representative group was approached with great care and was asked to participate in the evaluation process expressing a linguistic evaluation regarding each altemative under consideration. These groups were: 1) Environmentalists, 2) Policy-makers, 3) Local Associations, 4) Citizens, 5) Entrepreneurs and 6) Representatives of future generations.

The linguistic assessments could be expressed on the basis of a scale variable ranging from Perfect to Extremely bad (Perfect, Very good, Good, More or less good, Moderate, More or less bad, Bad, Very bad, Extremely bad).

This forum of representative groups was charged with the task to evaluate the four alternatives mentioned previously. The preferences expressed by each group, were ordered in an "equity matrix"(Table 4).

		Representative judgement groups					
Alternatives		Environmentalist	Public Administration	Local Association	Citizen	Entrepreneur	Future generation
	A	Ext. bad	Bad	Bad	Bad	Fairly good	Moderate
	B	Fairly bad	Moderate	Moderate	Bad	Moderate	Very bad
	C	Good	Moderate	Good	Fairly good	Bad	Fairly bad
	D	Very good	Ext. good	Very good	Ext. good	Very good	Ext. bad

Table *4 Equity matrix.*

4. The Application of NAIADE

In light of the above four altematives, our aim is to identify the most appropriate use of the natura1 resources of Lake Miseno. For this pourpose the NAIADE software was used; this is a "discrete" multi-criteria evaluation method that does not assume a traditional weighting of criteria (see also Section 2), but takes for granted imprecise preference statements.

After having defined the forum's responsiveness of the altematives to the evaluation criteria and having collected the information regarding the preferences on the development strategies, it is possible to define a ranking of altematives proposed through the application of the NAIADE.

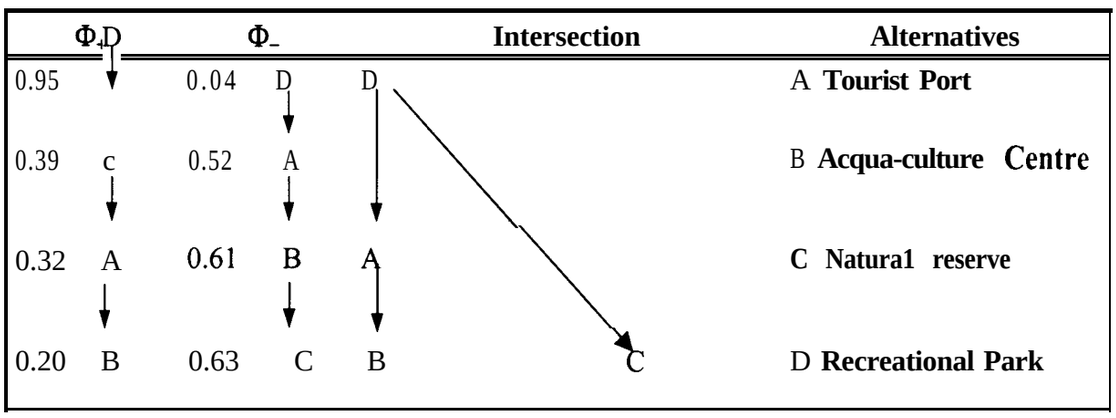


Figure 3 *Rank order of alternatives.*

As is shown in Figure 3, the final ranking originates from the intersection of two separate rankings: the first one Φ^+ is based on the better and much better preference relations and with a value rising from 0 to 1 it indicates that alternative A is better than all other altematives. The second one Φ^- is based on worse and much worse preference relations; its value ranges from 0 to 1, indicating that altemative A is worse than all other altematives.

The final ranking shows that altemative D - Recreational Park - is the most appropriate with respect to the specific evaluation criteria considered, and is best able to guarantee local development in terms of sustainability, as it is placed on the top of the hierarchy.

In the second place in the hierarchy, but way behind the results obtained by altemative D, is the institutional altemative A - Tourist Port. Even further down in the ranking we find altemative C - Nature Reserve and the institutional altemative B - Aquaculture Centre.

It is, therefore, plausible to assert that the altematives that tend to emphasise tourist potential and local attractions are preferable. In addition, among the altematives that operate in this sense, those that guarantee development and promote investment, profits and employment in the area, are preferable. Less satisfactory are the other strategies which tend clearly to favour only one of the objectives of sustainable development (economic efficiency, as in altemative B, or environmental conservation, as in altemative C).

The results obtained, far from being absolute, have to be assessed by politica1 decision-makers, who are responsible for public choices.

Finally, the compilation of the equity matrix allows the identification of the terms and conditions which make it possible to construct a coalition between the different social groups on specific development themes. The Equity Analysis provides the similarity index Gxy for each pair of interest groups, as well as the similarity of judgement on the proposed altematives that measure the possibility of groups x and y that find an accord regarding their different positions based upon shared proposals.

The dendrogram of coalition formation (see Figure 4) shows the immediate willingness of the Environmental Associations, the Citizens and the Local Associations to reconcile their positions.

The similarity index relative to the possibility that the G1 (Environmental Associations,) and G4 (Citizens) groups develop a coalition strategy is extremely high (0.784), and the similarity index relative to the possibility that the G3 group (Local Associations) finds a further common interest with the G1 and G4 is also high (0.775). Groups G5 and G6 (Entrepreneurs and Representatives of the Future Generations) are distant from the positions of these groups; their expectations and their values/objectives, which are not impossible to reach, however would require a process of dialogue.

In any case, the identification of a strategy, which may be shared by all groups, is possible, because the parametric index of similarity is a reassuring one (0.657). Interestingly enough, the Local Govemment (G2) appears to be sensitive to the needs, priorities, and positions of both the Environmental Associations, the Citizens and the Local Associations, as well as the Entrepreneurs and Representatives of Future Generations, and therefore is able to interpret

and join the social forces, and to exercise the necessary mediation activity between the interests in the field.

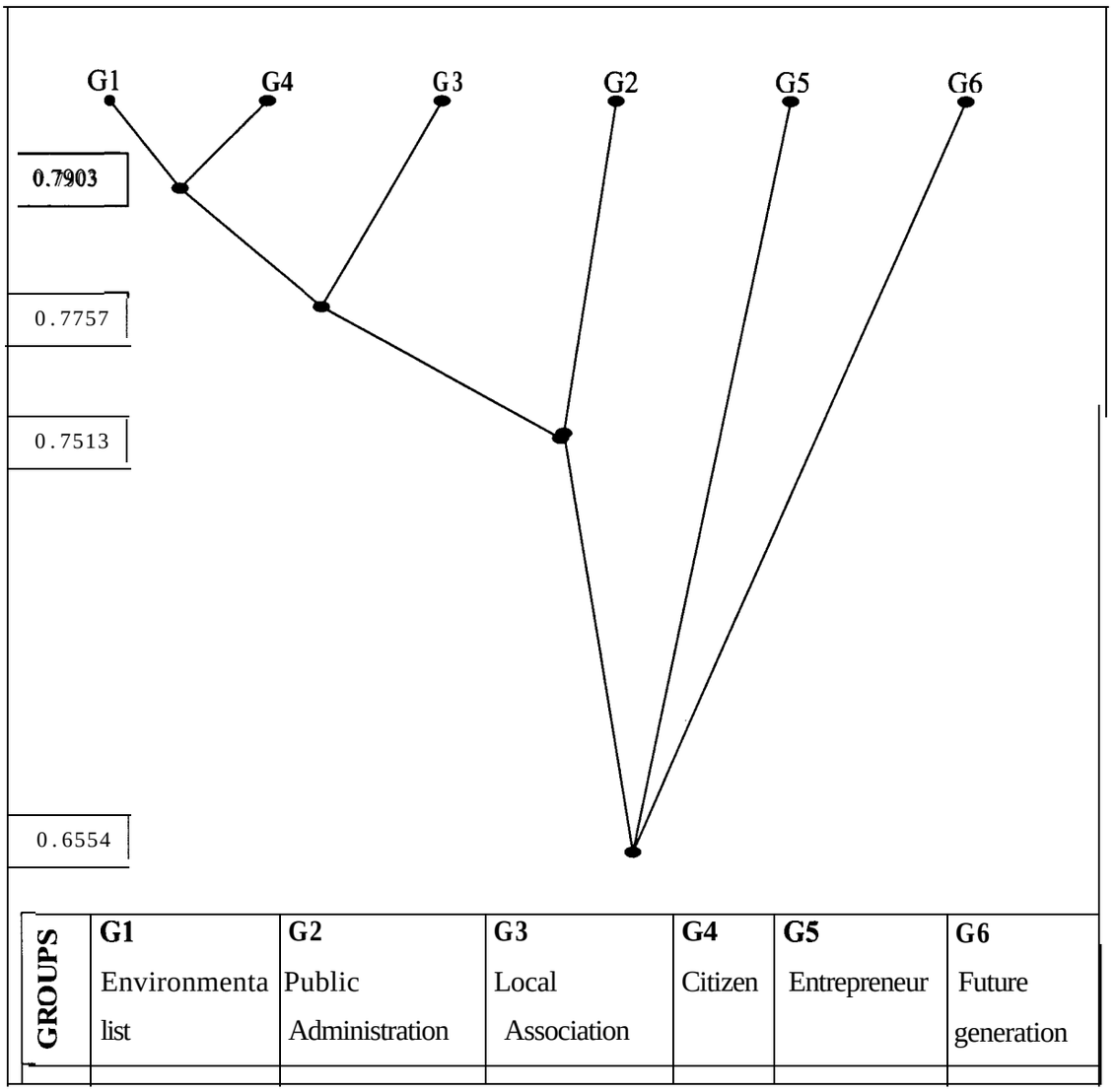


Figure *4 Dendrogram of coalition formation process*

5 Rank Order of Alternatives Using the Regime Analysis

The previously defined impact matrix, linked to the weight vectors calculated in the last section, has next been further analysed by means of the Regime method. The Regime method, as described in Section 2, allows US to analyse a matrix with mixed data linked with a weight vector, and to define a ranking of the altematives.

The results obtained (see Table 6, 7, 8) using a new software programme for multi-criteria analysis (the SamiSoft program) are expressed by an index of success for each altemative. This index indicates to what extent a project is preferable, compared to others.

In the case study under analysis, the software used for multi-criteria analysis considers all the input scores as benefit criteria, where the highest value is the best. In our impact matrix we have both cost and benefit criteria, so we have to transform the cost criteria into benefit values using a standardisation function (A_{min}/A) that is able to obtain values between 0 and 1 where the highest score is the best (Table 5).
Moreover, the software used required us to change the value expressed originally on a nomina1 scale into an ordinal one (1, 2, 3), where the highest value is the best.

	CRITERION	INDEX	A	B	C	D
Economic	1) Creation of new job (+)	Number of jobs	140	117	73	125
	2) Construction costs (-)	Billion lira	0.85	0.93	0.73	1
	3) Capacity to stimulate investment (+)	Qualitative	3	2	1	2
	4) Lake area for activity (+)	Square km	275	275	0	475
	5) Capacity to encourage new activity (+)	Qualitative	4	2	1	3
	6) Potential to attract local interest (+)	Qualitative	4	1	2	3
Social	7) Level of social utility (+)	Qualitative	2	1	2	3
	8) Capacity to encourage non-profit sector (+)	Qualitative	2	1	3	4
	9) Capacity to encourage cooperation(+)	Qualitative	2	3	1	2
	10) Level of reversibility of action(+)	Qualitative	1	2	4	3
Environment	11) Interference with migratory fauna(+)	Qualitative	0	0	1	1
	12) Risk of water clouding (+)	Qualitative	0	0	1	1
	13) Conservation of bio - diversity (+)	Qualitative	1	1	0	0
	14) Level of air pollution (+)	Qualitative	1	3	3	2
	15) Level of integration of landscape (+)	Qualitative	1	2	4	3
	16) Level of integration with local culture(+)	Qualitative	1	1	1	2

Table 3 *Standardised impact table*

Results of the Regime Method

Criteria	Intermediate results				Final results			
Economic	A	B	C	D				
	0,99	0,36	0,01	0,65				
Social	A	B	C	D	A	B	C	D
	0,22	0,19	0,62	0,98	0,39	0	0,61	1
Environment	A	B	C	D				
	0	0,37	0,93	0,7				

Table 6 *Rank-order of alternatives using the uniform weight vector.*

We find, when examining the intermediate results of the Regime analysis using the uniform weight vector (Table 6) for:

- the economic criteria, alternative A is preferable to the other two, as it provides the highest number of new jobs; it also does not present high investment costs;
- the social criteria, alternative D obtains the highest values, in the light of its capacity to encourage the non-profit sector and to contribute to improving the leve1 of social utility;
- the environmental criteria, altemative C is preferable to the others; in fact, the idea of creating a natura1 reserve shows most respect for the biological and natura1 issues.

Looking instead at the final results, altemative D is preferable. The suggestion to create a recreational park was the best combination of economic, social and environmental issues, as we have already seen in the previous section.

Criteria	Intermediate results				Final results			
Economic	A	B	C	D				
	0.99	0.34	0.08	0.59				
Social	A	B	C	D	A	B	C	D
	0.4	0.32	0.38	0.9	0.46	0.21	0.46	0.87
Environment	A	B	C	D				
	0.01	0.34	0.9	0.75				

Table 7 *Rank-order of alternatives using the weight vectorfrom the point of view of experts*

Criteria	Intermediate results				Final results			
Econimic	A	B	C	D				
	1	0,37	0,03	0,6				
Social	A	B	C	D	A	B	C	D
	0,33	0	0,67	1	0,64	0,21	0,19	0,96
Environment	A	B	C	D				
	0	0,63	0,9	0,47				

Table 8 *Rank-order of alternatives using the weight vector from the point of view of Public Administration*

Tables 7 and 8 show, instead, the results obtained by the preferences expressed by the experts and Public Administration. Looking both at the intermediate and the final results, apart from a few differences in the values, they reflect perfectly the same results as obtained from the first analysis. So also in these other two cases, altemative D is preferable.

In the next section we will apply the Flag model to assess the sustainability of each altemative in relation of a set of critical threshold values.

6 The Application of the Flag Model

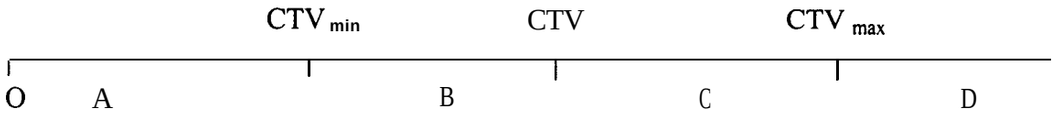
In this section, we will illustrate the application of the Flag model to the case study under analysis to check the sustainability of the altematives in regard to a set of threshold values.

This analysis, carried out with the use of special software (the Flag model) includes a program for multi-criteria analysis (the Saaty program). There are two inputs to this program: an impact matrix and a set of critical threshold values. Therefore, for each of the relevant criteria included in the impact matrix previously described in Section 3.3, it is necessary to establish a critical threshold value (CTV).

The concept of critical threshold value is related to the normative concept of sustainability (see Nijkamp and Ouwersloot, 1998, where due attention is focussed on the question of how sustainability can be identified as a normative orientation for policy). In other words, the question is whether it is possible to define a set of reference values or threshold values (limits, standards norm) on resource use and environmental degradation (pollution) to check the impact of policy strategies and projects on the environment and society.

In this context, the notion of carrying capacity is of great importance, as it indicates the maximum environmental stress that is stil1 compatible with an ecologically sustainable economic development. This means that this concept refers to a threshold value that cannot be exceeded without causing unacceptably high damage and risk to the environment. Clearly, for each sustainable indicator, be it environmental or socio-economie, a CTV has to be specified, so that an entire set of CTV' s may act as a reference system for judging actual states or future outcomes (see Figure 5).

A major practica1 problem is the fact that the CTV leve1 is not always unambiguous. In certain areas and under certain circumstances different expert and decision-makers may have different views on the precise leve1 of an acceptable CTV. A relatively simple and manageable approach to the above uncertainty problem is to introduce a bandwidth for the corresponding sustainability indicator. A minimum value, CTV min, may be seen as the threshold value on which the most conservative opinion agrees that it may eventually be a negative impact (min-max condition). CTV max, on the other hand, refers to the maximum allowable value of sustainability indicators, beyond which an alarming development will certainly start (max-max condition) (Nijkamp and Ouwersloot, 1997).



Section A	Green flag	no reason for specific concern
Section B	Orange flag	be verv alert
Section C	Red flag	reverse trend
Section D	Black flag	Stop further growth

Figure *5 Representation of critical threshold values in Flag model*

In our specific case, the bandwidth of critical threshold values has been defined on the basis of the judgement expressed by the group of experts involved, due to lack of normative reference values. This applies in particular when looking at the economic criteria for:

- construction costs: we consider as a limit the budget available to achieve the re-qualification of the area established in the Renewal Plan, to be CTV = 59 bln of Lira;
- all other criteria with a qualitative score: we assume that the value 2 in the predefined ordinal scale (1,2,3,4) represents the minimum allowable value of sustainability indicators beyond which an alarming development would set in.

Table 9 shows the results of the frequency of flags in regard to each relevant class of criteria and the total scores for each alternative. Moreover, Figure 6 show the frequency of flags for each alternative in a qualitative sense in a cluster column chart.

	ALL FLAG				BIOPHISICAL INDICATORS				ECONOMIC INDICATORS				SOCIAL INDICATORS			
	B	R	Y	G	B	R	Y	G	B	R	Y	G	B	R	Y	G
A	10	0	0	4	6	0	0	0	1	0	0	3	3	0	0	1
B	11	0	0	3	6	0	0	0	2	0	0	2	3	0	0	1
C	8	0	0	6	1	0	0	5	4	0	0	0	3	0	0	1
D	1	0	0	13	1	0	0	5	0	0	0	4	0	0	0	4

Table 9 *Frequencies of flags*

B= Black flag: stop further growth

R= Red flag: reverse trend

Y= Yellow flag: be very alert

G= Green flag: no reason for specific concern

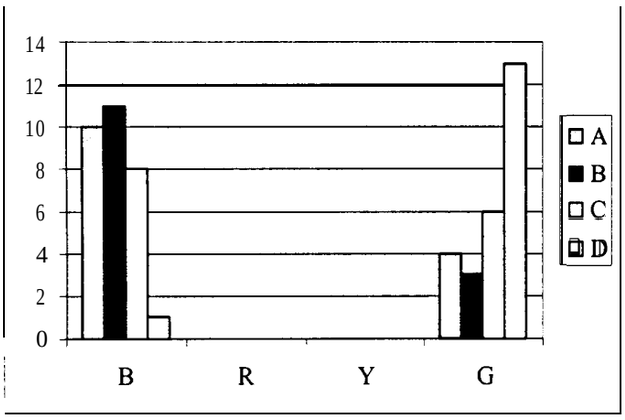


Figure 6 *Frequency of flags*

Looking at the results of Table 9, we can see that altemative D is the one that presents a large number of green flags. In fact, it has only one black flag that reflects the possibility for this altemative to create air pollution.

In second place, we have altemative C, which in any case presents 8 black flags, mostly concentrated on economic and social issues.

Altematives A and B seem to be unsustainable, when we look at the environment. Clearly, Figure 6 shows, in a qualitative sense, the same results as Table 9.
In the next section we will compare the results obtained from all multi-criteria methods that we have previously applied to check the consistency of the results and the reliability of the methods.

7. Comparison of Results from Different Methods and Conclusions

In the previous sections, we have established the various rank orders of the altematives using several different methods: the AHP method, the Regime analysis and the NAIADE method combined with the Flag model.
From the Regime analysis, we have obtained three rankings of the altematives considering different systems of weights linked with the criteria, while from NAIADE we found a ranking of altematives that reflect the preferences expressed by the six groups that have taken part in the forum. The Flag model is capable of checking the sustainability of each altemative compared to a set of critical threshold values. In this way we are able to define if an altemative is acceptable or not. Table 10 summarises the results obtained and makes a comparison between the different rank orders.

	NAIADE		REGIME			FLAG
	Φ^+	Φ^-	W_1	W_2	W_3	
1	D	D	D	D	D	D
2	C	A	C	A	A	C
3	A	B	A	C	B	B
4	B	C	B	B	C	A

Table 10 *Comparison between different rankings*
Legend W_1= *uniform weight vector*
W_2= *weight vector from the point of view of the experts*
W_3= *weight vectorfrom the point of view of Public Administration.*

From the results of Table 10, we can see that altemative D always takes a first place, while altemative A appears most frequently on a second position. Altemative B, on the other hand, is the most frequent choice at the fourth level, and so we can confirm that it is the least suitable in this context.
In conclusion, altemative D (Recreational Park) seems to be preferable, because it is the one that best fits the economic issues, as it tends to emphasise tourist potential and local attractivity. In addition, among the altematives, this is the one that mostly guarantees economic development, promotes investment, profits and employment, while at the same time it respects the area's environmental attributes.
We conclude that the different methods used confirm these results and seem to be reliable tools for reaching a shared choice in the planning process.

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